What is claimed is:

1. In a charged-particle-beam (CPB) microlithography system comprising, on an optical axis, a CPB optical system including an illumination-optical system and a projection-optical system, wherein the illumination-optical system illuminates a selected region on a reticle with a charged-particle illumination beam to form a patterned beam carrying an aerial image of the illuminated reticle region, and the projection-optical system causes the patterned beam to form an actual image of the illuminated reticle region on a corresponding region on a surface of a substrate, a device for detecting and canceling magnetic fields external to the CPB optical system, comprising:

a magnetic-field sensor situated and configured to detect a magnetic field external to the CPB optical system;

a magnetic-field-compensation coil situated between the illumination-optical system and the projection-optical system or between the projection-optical system and a substrate stage; and

a magnetic-field-compensation circuit connected to the magnetic-field-compensation coil and configured to deliver an electrical current to the magnetic-field-compensation coil sufficient in direction and magnitude to cause the magnetic-field-compensation coil to produce a corresponding magnetic field that cancels at least a portion of the external magnetic field detected by the magnetic-field sensor.

2. The device of claim 1, wherein:

the microlithography system comprises a reticle stage situated between the illumination-optical system and the projection-optical system;

the reticle is mounted on the reticle stage; and

the magnetic-field sensor and the magnetic-field-compensation coil are situated between the illumination-optical system and the reticle stage.

3. The device of claim 1, wherein:

the magnetic-field sensor and magnetic-field-compensation coil each comprise a respective set of three coils, one coil for each of an x-axis direction, a y-axis direction, and a z-axis direction, respectively, of a Cartesian coordinate system of the CPB optical system, wherein the optical axis is parallel to the z-axis direction;

the coils of the magnetic-field sensor detect respective components of the external magnetic field in the x-axis, y-axis, and z-axis directions, respectively; and

the coils of the magnetic-field-compensation coil generate respective magnetic fields in the x-axis, y-axis, and z-axis directions, respectively.

4. The device of claim 3, wherein the coils of the magnetic-field sensor comprise:

a z-axis coil wound about the z-axis and configured to detect a magnetic field in the z-axis direction;

an x-axis coil wound about an axis parallel to the x-axis and configured to detect a magnetic field in the x-axis direction; and

a y-axis coil wound about an axis parallel to the y-axis and configured to detect a magnetic field in the y-axis direction.

5. The device of claim 4, wherein the coils of the magnetic-field-compensation coil comprise:

a z-axis coil wound about the z-axis and configured to generate a magnetic field oriented in the z-axis direction;

an x-axis coil wound about an axis parallel to the y-axis and configured to generate a magnetic field oriented in the x-axis direction; and

a y-axis coil wound about an axis parallel to the x-axis and configured to generate a magnetic field in the y-axis direction.

6. The device of claim 1, wherein the magnetic-field sensor is displaced from the optical axis farther than the magnetic-field-compensation coil.

7. The device of claim 1, wherein the magnetic-field sensor comprises a coil configured to serve as both a magnetic-field sensor coil and a magnetic-field-compensation coil.

8. The device of claim 1, further comprising:

a first magnetic-field sensor and a first magnetic-field-compensation coil situated between the illumination-optical system and the projection-optical system;

a second magnetic-field sensor and a second magnetic-field-compensation coil situated between the projection-optical system and the substrate stage;

a first magnetic-field-compensation circuit connected to the first magnetic-field-compensation coil; and

a second magnetic-field-compensation circuit connected to the second magnetic-field-compensation coil.

9. The device of claim 8, wherein:

each of the first and second magnetic-field sensors and each of the first and second magnetic-field-compensation coils comprises a respective set of three coils, one coil for each of an x-axis direction, a y-axis direction, and a z-axis direction, respectively, of a Cartesian coordinate system of the CPB optical system, wherein the optical axis is parallel to the z-axis direction;

the respective coils of each magnetic-field sensor detect respective components of the external magnetic field in the x-axis, y-axis, and z-axis directions, respectively; and

the respective coils of each magnetic-field-compensation coil generate respective magnetic fields in the x-axis, y-axis, and z-axis directions, respectively.

10. The device of claim 9, wherein the coils of each magnetic-field sensor comprise:

a respective z-axis coil wound about the z-axis and configured to detect a magnetic field in the z-axis direction;

a respective x-axis coil wound about an axis parallel to the y-axis and configured to detect a magnetic field in the x-axis direction; and

a respective y-axis coil wound about an axis parallel to the x-axis and configured to detect a magnetic field in the y-axis direction.

11. In a charged-particle-beam (CPB) microlithography method in which an illumination beam is directed by a CPB optical system onto a selected region of a pattern-defining reticle to produce a patterned beam carrying an aerial image of the illuminated reticle region, and the pattern beam is caused by the CPB optical system to form an actual image of the illuminated reticle region on a corresponding region on a surface of a substrate, a method for detecting and canceling magnetic fields external to the CPB optical system, the method comprising:

detecting a magnetic field external to the CPB optical system;

placing a magnetic-field-compensation coil relative to the CPB optical system; and

based on the detected external magnetic field, supplying electric current to the magnetic-field-compensation coil to produce a corresponding magnetic field that cancels at least a portion of the detected external magnetic field.

12. The method of claim 11, further comprising the steps of:

determining a ratio of the detected external magnetic field and the electric current supplied to the magnetic-field-compensation coil in advance; and

determining the electric current supplied to the magnetic-field-compensation coil based on the detected external magnetic field and the ratio.

13. A CPB optical system, comprising a device as recited in claim 1.

14. A CPB microlithography apparatus, comprising the CPB optical system of claim 13.

15. A CPB microlithography process, performed using the CPB microlithography apparatus of claim 14.

16. A process for manufacturing a microelectronic device, comprising a CPB microlithography process as recited in claim 1.